USAID / West Africa

Expanded Agribusiness and Trade Promotion (USAID E-ATP)

USAID / Mali

Initiatives Intégrées pour la Croissance Economique au Mali (IICEM)

Training Manual

System of Rice Intensification (SRI)

Achieving More with Less: A new way of rice cultivation

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Introduction

The *Expanded-Agribusiness and Trade Promotion* (USAID E-ATP) project is a regional initiative financed by the United States of America through USAID. This 3-year project running from 2009 to 2012 aims to increase the value and volume of intra regional trade of essential products in West Africa and therefore, contributes to food security in the region. The project focuses on six value chains, including rice. Given the critical and strategic role of rice in food security programs, it is essential to promote innovative technologies.

In order to improve the productivity of rice farmers and subsequently increase the local rice competitiveness against the imported rice, USAID E-ATP project has engaged into disseminating the System of Rice Intensification (SRI) which allows to increase the yield from 35% to 100%.

The USAID bilateral project for Mali named "*Initiatives Intégrées pour la Croissance Economique au Mali* (IICEM)" has promoted this technology which increases the yields, generates surpluses for markets and encourages competiveness of local production, boosts intra-regional rice trade and contributes to food security. USAID E-ATP as part of its Value Chain Development Plan (VCDP) is disseminating the SRI technology which is adapted to small rice farmers through the training of trainers followed with step down trainings.

1. Definition

The SRI is a way of harmonizing the elements of **soil-water-plant-sunlight** to allow the plant to achieve its fullest potential of production, often hidden when inappropriate techniques are used. In practical terms, it's a method of producing rice using fewer seeds, less water and fertilizer, cost-saving labor practices, and well-aerated soil rich in organic material. In sum, SRI is achieving more with less.

Unfortunately, for hundred years and worldwide, some farming practices have reduced the production potential of rice. This new system of rice intensification is an improvement over conventional growing techniques by allowing maximum productivity.

1.1 Background of SRI

It was Father Henri de Laulanié, an agriculturalist who initiated the SRI in Madagascar where he worked from 1961 to 1995 with Malagasy farmers, students and friends to improve the rice production in the country. For decades now, rice farmers and scientists have carried out a lot of researches and evaluations on the SRI in many other countries.

SRI was introduced in Mali in 2007 by the NGO Africare which tested it in the Tombouctou area. Impressed by the results, IICEM extended the trials in four Malian regions; Gao, Tombouctou, Mopti (with controlled use of water) and Sikasso (rain-fed type), and then joined with the USAID E-ATP project to expand this system throughout West Africa. The outcomes of SRI, trials in Mali were shared at a regional workshop in 2010 (organized both by USAID E-ATP and IICEM) attended by eight West Africa countries.

1.2 The six principles of SRI compared with common practices

Rice growing Technique	SRI	Common practices
Land preparation	Good: tilling, mudding, leveling	Good: tilling, mudding
Transplanting 1	Age of seedlings: 10-15 days	21, generally 30-40 days
2	Number of seedlings :1 on line	3-4 seedlings in quincunxes
3	dimension: 25 X 25 cm	15-15cm in quincunxes
Fertilization 4	Organic Manure 10-15T/ha Complementary mineral fertilizer: 1/3 -1/2	Small dose of OM mineral fertilizer: 200 Kg urea N) 100Kg of Phosphate
Irrigation 5	Intermittent humidity and drought: water 3-5 cm	Water: 15- 40 cm
Rotary weeding 6	Tilling; 2-4 times	No tilling

The six principles are as follow:

1- Seedlings get transplanted at a much younger age

2- Only single seedlings, instead of a handful of seedlings get planted in each hill

3- Plants are spaced wider apart and in a square pattern

4- Increased use of organic fertilizer to enhance soil fertility

5- Intermittent water application to increase wet and dry soil conditions, instead of continuous flood irrigation

6- Rotary weeding to control weeds and promote soil aeration.

2 Preparation of soil

In general, a good preparation of soil is essential to ensure effective yield. But for the particular case of the SRI, this is more than essential since this method develops a better root system, a larger amount of vegetation, and a maximum paddy production. It is therefore crucial that the first 20 cm of the top soil are well loosened. The following steps should be carried out one month ahead and completed one week before the transplanting activity: (i) ploughing, (ii) muddying, and (iii) levelling.

2.1 Ploughing

Ploughing is done 2 or 3 days after the pre irrigation or after the first rains. Where good irrigation is done, farmers may wait up to one week before undertaking the ploughing because this can help in an initial fight against weeds. After their germination, these weeds will be buried at the same time as the manure that has been applied as organic fertilizer.

Ploughing can be done manually or animal-drawn for small and medium size plots respectively. Tractors can be used for bigger plots. Good ploughing facilitates a good levelling of the plot.

2.2 Watering and putting to mud the plot

The SRI recommends essential steps in preparing the rice field which are: i) good watering of the plot followed by ii) putting it to mud and iii) levelling it. Depending on the soil, you use creativity and innovation to achieve successfully the last two activities.

2.3 Leveling of the plot

Leveling must be properly done given that the system is to alternate watering and drying of the plot. Simple equipment, including a levelling bar, power tiller, or tractor can be used.

For ground levelling, we can use a stick of 4 -6 m which is pulled in the mud. Harrows or their backs can also be used. The stick is pulled throughout the field to scrape the soil elevations and fill the depressions and gullies in order to get a surface which is adequately graded. For levelling small plots of land or those already graded, use spades, rakes or hoes when putting to mud has already been done.

2.4 Applying organic fertilizer

Fertilization is based on the use of organic manure. It is recommended that 10-15 tons be applied per hectare. Mineral fertilizers should be used only to address nutritional deficiencies. In practice, we did not exceed 1/3 of the usual quantities used.

Organic fertilizer enriches and improves the structure of the soil, particularly in irrigated areas which experience greater leaching due to the quantity of water that flows and is poorly drained.

Organic fertilizer is applied before ploughing which allows it to be buried in the soil.

3 Setting up the nursery

3.1 Preparation of the seedbed (nursery)

The SRI nursery is designed exactly like a vegetable plot, 1m wide and 4 to 10m long. You'll use 100 square meters to transplant 10,000 square meters or 1 hectare (ha). The seedbed will be covered with very loose, light soil with a depth of 15 cm (the root length is about 10 cm). To sow the seedbed, use 8.5 kg of seed to transplant 10,000 square meters (1 ha). It is recommended to mix sand and manure while taking into account the fact that often, some soils contain a lot of clay.

3.2 Preparation of seeds

According to the size of your rice farm, calculate the quantity of seeds and the size of the nursery as follow. 8.5kg of seeds are needed to transplant 10 000 m² (1ha). Use scale to weight the seeds. Put the seeds in warm water for a period of 24 hours. Floating grains must be removed because they are empty.

Table 1: Assessment of the quantity of seeds and the size of the nursery

Quantity of Seeds	Nursery dimension	Rice field
0.085kg	**1 m²**	**100 m² ou 1 are**
0.255kg	**3 m²**	**300 m² ou 3 ares**
0.85kg	**10 m²**	**1 000 m² ou 10 ares**
2.25kg	**30 m²**	**3 000 m² ou 30 ares**
4.25 kg	**50 m²**	**5 000 m² ou 50 ares**
6.375 kg	**75 m²**	**7 500 m² 75 ares**
8.5kg or 8500g	**100 m²**	**10000 m² ou 100 ares ou 1 hectare**

3.3 Sowing

To sow the nursery/seedbed, set aside the grains that float, because they're empty. Divide the seeds into three parts: one-third for sowing the first half of the seedbed, and one-third for sowing the second half of the seedbed. The last third will be used to fill the empty spaces.

The first step is to water the plot with a watering can or by hand. The pre-germinated paddy seeds are hand sowed. Use the shovel handle to plane the surface and hit slightly with the palm of your hands to toss the soil. After sowing spread seeds with hand on the surface of the seedbed, cover the grains with a little sand mixed to mulch or manure. If it is hot, cover the plot with straw after taking care of its sides from erosion or predator by using wood or rocks to protect them.

Since the transplanting will be done with seedlings that have lumps of dirt attached to them, it's essential to thin out the nursery. As germination starts, from the second through fifth day, gradually remove the straw.

3.4 Watering the nursery

Water the nursery with watering cans. It is recommended that the nursery should be located near a water point. Since putting in place a nursery is simple, some have started developing them at home where later the seedlings to the farm are carried to be transplanted in the field. Use small trays or racks to do so.

Just after the sowing of the seedbed, water very slightly. The seeds must not be exposed to predators. From the second day, the watering takes place in the morning and afternoon. With the seedlings sprout (from the second to the fifth day), we gradually start to remove the straw or shading. Transplanting begins when the seedlings have two leaves 10-15 days after sowing.

4 Transplanting of seedlings

4.1 Transfer of the seedlings

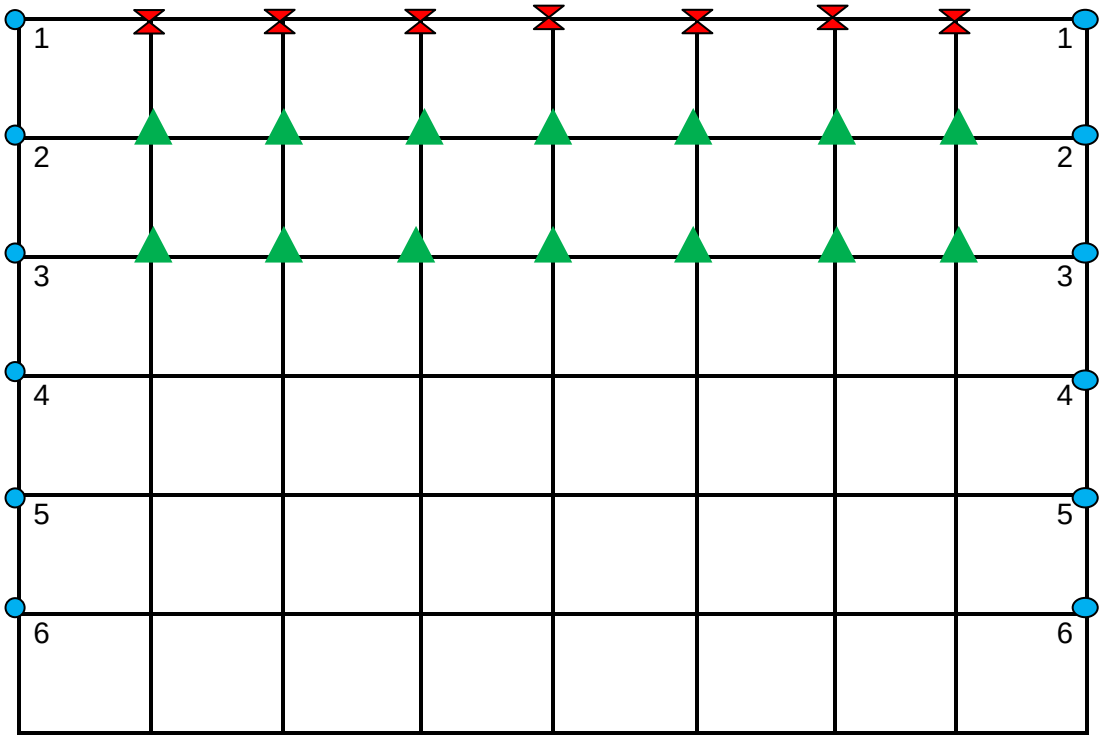
Use a hoe or shovel to remove the seedlings from the nursery and give them to the team in charge of the transplanting. This should not exceed 30 minutes to avoid drying of the seedlings roots.

Removing the seedlings

The seedling before transplanting

4.2 Transplanting of seedlings

Unlike the traditionally practice the transplanting operation for SRI needs to be carefully carried out. When the seedlings have (2) leaves (on the 10th day), the transplanting work starts. It has to be done in a muddy plot with sticky water. The young seedlings are transplanted in line at a distance of 25cm from each other and lined out using a rope marked every 25 cm. This facilitates the transplanting activity in both directions.



Taking out the seedlings with small soil attached to the roots, allows it to recover 24 hours earlier than in the conventional practice, where it needs four days before recovering. The seedlings should be lightly sliding in the mud, in the form of the letter « L » (as opposed to the « J » shape used in the traditional method).

Following transplanting, the plot is lightly irrigated to maintain humidity during the first two weeks. Avoid jets of water and compensatory planting is possible.

String position while transplanting

Seedling transplantation

5 Irrigation

The principle of irrigation in SRI is to alternate irrigation with drying out the soil. Standing water, used mainly to control weeds, is not advisable. Start this type of irrigation on the second week after transplanting. Water is sent to soak the soil up to a level of 2 cm. Stop irrigating and allow for the soil to dry out until cracks are seen, which then means watering is needed. During the flowering period, ensure to maintain a water head worth 2-3 cm (mains the water covers your big toe).

Observation of the soil

Observation of the plants

Soil just before watering

6 Weeding

6.1 Weeding and rotary weeding

Removal of weeds is part of the key activities involved in the SRI mainly due to the fact that water is not permanent in the field to control the casual weeds.

Pricking out in rows will allow us to use a manual or mechanized weeder and have control over the harmful grasses. Manual weeding is necessary in the first and second week after transplanting because the seedlings are still fragile and sticking to the grass. The weeder can be used from the 20th day following the transplanting. Although weeding should take place every 10 days, it is necessary to consider the extent to which the plot is covered with grass. Four weeding operations are required to ensure a good formation of tillers which characterises SRI. Weeding should not go beyond 1-2 cm of the subsurface and cross-weeding is recommended.



A rotary weeder is recommended. Hoeing consists of removing soil to help aerate it, which in turns helps good root development. When weeds are cut and re-buried into the soil, they decompose and become fertilizer. A rotary weeder also contributes to better levelling of the land. It saves on the cost of working by hand, without compromising quality.

6.2 Advantages of weeding

The rotary weeder works to keep the weeds down in the soil. By doing this, weeds which are cut and mixed in the soil by the hoe will rot and fertilize it. The rotary weeder works at the sub-surface level.

Successive weeding is good to ensure a good-aerated soil and subsequently, good growth and development of the roots which will draw from the soil the nutrients to ensure good tilling. All these operations, together with a well prepared soil using organic matter are factors which help the plant to maximize all its production potential. The plant is no longer in the airtight environment like the traditional rice growing practice where hoeing is not used.

Producers like this tool very much as it delivers quality work and helps in saving a lot of money required for the weeding activity.

7 Outcomes and some achievements

7.1 Outcomes

For the exception that there may be more crops to reap, harvesting of SRI is the same as the traditional harvesting. Harvester groups see that as a difficulty but a positive one: having to harvest a lot of crops!

7.2 Achievements in Mali (2010-2011 crop)

Area	Number of sites	Yield (t/ha)	
		SRI	Control plot
Gao	9	10,0	7,1
Tombouctou	9	9,1	7,2
Tombouctou (village irrigated perimeters)	3	11,1	8,8
Mopti	15	8,3	6,5

8 Comparative Analysis between SRI and existing practice

Activity	SRI	Existing Practice
Nursery	- 8-10 kg of seeds per /ha - grain seeping : 24h	- 50-60 Kg seeds per ha - dry sowing
Transplanting	- 8-12 days (2 leave stage with earth around the roots) - 1plant /hill and in line - space 25cm x25cm	- transplanting: 21-30 days (with washed roots, leaves size reduced) - 3-4 Plants/hill placed alternately - spacing 15cm x 15cm, 15cmx20cm, 20cm x 20cm
Fertilization	- use of organic fertilizer mainly: 10-15 t/ha	- limited use of organic fertilizer - fertilizer: DAP 100kg/ ha - urea: 200kg/ha
Irrigation	- humidity is kept - lack of water jet	- keep water pressure over 10cm
Weeding	- Mechanized weed control - Time saving - 4 weeding are enough	- Manual weeding - High labor cost - Need for 1-4 manual weeding
Weeding -hoeing	- Mechanization - Aerated soil	- This activity does not exist
Yield	- Increased yield 35-100% against the average yield - Range: 4 to 12 t/ha - Average over 8 t/ha	- Average yield 2-3 t/ha - Range: 3-7 t/ha - Average: 5 t/ha

9 Advantages and challenges of SRI

Advantages	Constraints
- Saves more than 80% seeds - Saves fertilizers - Saves water (35%) - Reduces labor for weed control (over) 70% - Saves time in the production cycle (2-3 weeks) - Increases the yield by 35%- 100% - Requires low production costs (saving seeds, fertilizers, fuel, labor)	- Psychological effect of change - Use of a lot of organic fertilizer - Careful transplanting required at the start - Working the soil is necessary - Necessity of equipment including weeder and the leveling bar

Other benefits of SRI: i) improve productivity, ii) increase the marketable surplus iii) increases income, iv) sustainable soil management v) is a response to climate change.

Conclusion

The purpose of this manual is to show how rice can be produced differently. Like any other business, profit making underpins the rice growing activity. In other terms, it is about making the rice farming a business which generates substantial incomes.

The SRI has good prospects for the small farmers of West Africa as it aims to improve their production and make them earn more money.

One major reason given by farmers and other people who do not adopt the SRI is the great amount of work it requires. Any change demands a lot of work and more efforts arising from the more attention and arrangements involved. In any case, the SRI requirements are not to be seen only in terms of physical investments but also a behaviour change towards. Farmers should, in the long term, consider that SRI requires less work but will make you richer.

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